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(54) [Title of the Invention] LIQUID CRYSTAL DISPLAY DEVICE AND METHOD FOR MANUFACTURING THE SAME

(57) [Summary]

[Object] The present invention relates to a structure of an active matrix type liquid crystal display device using a thin film transistor as a switching element and to a method for manufacturing the same. It is an object of the invention to provide a liquid crystal display device in which the resistance of each wiring is attempted to be lowered at the same time of reducing the number of manufacturing processes and the incidence rate of disconnection defects of each wiring.

[Structure] Regarding a scanning wiring transistor and a signal wiring which drive a thin film transistor, when a first scanning wiring 17(a) is formed, a first signal wiring 17(b) which is to be part of a signal wiring is simultaneously formed, and further, when a second signal wiring 16(a) is formed, a second scanning wiring 16(b) which is to be part of a scanning wiring is formed. A redundant structure is attempted at the same time of reducing the number of patterning by being electrically in contact with each wiring partially through opening contact portions 18 and 19.

[Advantageous Effect] Since the number of patterning can be reduced, and further, each wiring can be made to have a redundant structure, it is effective in reducing the number of manufacturing processes, significantly reducing the incidence rate of disconnection defects, and preventing the delay of a signal by reducing the resistance of each wiring.

[Scope of Claim]

[Claim 1] A liquid crystal display device, wherein a liquid crystal is sealed over a pair of substrates, comprising pixel electrodes arranged in matrix over one of the substrates; a thin film transistor which is adjacent to and connected to the pixel electrode; a signal wiring connected to the source electrode of the thin film transistor; and a scanning wiring connected to the gate electrode of the thin film transistor, wherein at least either

the signal wiring or the scanning wiring includes two-layer wirings of first and second wirings; an insulating layer having an opening is provided between the first and second wirings; and two-layer wirings of the first and second wirings are disposed to keep an electric contact.

[Claim 2] A liquid crystal display device according to Claim 1, wherein either a first or second wiring constituting a scanning wiring or a signal wiring is provided excluding an intersecting portion between the scanning wiring and the signal wiring.

[Claim 3] A method for manufacturing a liquid crystal display device according to Claim 1 or Claim 2 is characterized in that when a first scanning wiring is formed, a first signal wiring is simultaneously formed, and when a second signal wiring is formed, a second scanning wiring is simultaneously formed.

[Detailed Description of the Invention]

[0001]

[Industrial Field of the Invention] The present invention relates to a liquid crystal display device, in particular, to an active matrix type liquid crystal display device using a thin film transistor as a switching element and a method for manufacturing the same.

[0002]

[Prior Art] In recent years, according to the development of a fine processing technique and a liquid crystal material, a television image display device using a liquid crystal panel is provided for commercial. As its system, a so-called active matrix system incorporating a switching element in each pixel is becoming a mainstream from the advantageous point of view such as high-contrast and high-resolution.

[0003] FIG. 4 shows an equivalent circuit of an active matrix type liquid crystal panel, and for example, a switching element 3 of a field-effect type thin film transistor (hereinafter, referred to as a "field-effect type transistor") and a liquid crystal cell 4 are disposed at each intersection of a scanning line group 1 and a signal line group 2. Reference numeral 5 denotes a counter electrode including a transparent conductive

second scanning wiring, and further, the first signal wiring and the second signal wiring with each other through an opening formed in part of the insulating layer in advance, the scanning wiring and the signal wiring are formed.

[0011]

[Effect] According to the above-mentioned structure of the present invention, a conductive layer having a scanning wiring and a signal wiring therein can be used, and each of the scanning wiring and the signal wiring can be configured to have a plurality of layers. Therefore, even when disconnection is generated in one of the conductive layers, the defect can be compensated by the other conductive layer. Especially, by only forming each layer of the scanning wiring and the signal wiring, each wiring has a two-layer structure except for part. Therefore, the number of manufacturing processes can be reduced with quality kept high. Additionally, each of the scanning wiring and the signal wiring can be made to have lower resistance since the scanning wiring and the signal wiring are made of a conductive layer having a plurality of layers. Accordingly, for example, in a scanning wiring, measures for an image defect such as luminance inclination in the direction of a scanning wiring due to the delay of the applied scanning signal is taken, thereby achieving the lower resistance which is sufficient to provide a normal image.

[0012]

[Embodiment] FIG. 1 shows a plane layout view of a unit pixel of an active matrix type liquid crystal display device by an embodiment of the present invention, FIG. 2 shows a cross-sectional view taken along the line A-A' in FIG. 1, and FIG. 3 shows a cross-sectional view taken along the line B-B' in FIG. 2.

[0013] First, as shown in FIG. 1, a pixel electrode 20 including a transparent electrode is patterned and formed over a glass substrate. Electrically separated from the pixel electrode 20, first scanning wiring 17(a) and first signal wiring 17(b) which is to be part of a signal wiring are patterned by a photo-etching method using conductive layer of the

same layer (such as Cr and Al) electrically separated from the first scanning wiring 17(a). Next, over the first scanning wiring 17(a) and the first signal wiring 17(b), as shown in FIG. 2 and FIG. 3, a first insulating layer 26 (for example, $Si_3N_4$) for keeping insulation between a second signal wiring 16(a) and a second scanning wiring 16(b) to be formed later is formed at least over the first scanning wiring 17(a) and the first signal wiring 17(b). In a field-effect type transistor portion, a first amorphous silicon layer 21 which hardly contains an impurity, and a second insulating layer 22 are sequentially deposited over the first insulating layer 26, and then, the second insulating layer 22 is patterned to have an island-like shape in a channel portion of the field-effect type transistor as an etching stopper at the time of forming the second signal wiring 16(a), the second scanning wiring 16(b) and a drain wiring 23 later. Then, for the purpose of improving ohmic characteristics among the first amorphous silicon layer 21, the second signal wiring 16(a) and the drain wiring 23, for example, after depositing a second amorphous silicon layer 25 containing phosphorus, it is patterned to have an island-like shape in the field-effect type transistor in the same manner as the first amorphous silicon layer 21. Then, opening contact portions 18, 19 and 24 to obtain electric continuity between the second signal wiring 16(a), the second scanning wiring 16(b) and the drain wiring 23, and its wiring and electrode, are provided. Then, a conductive layer is formed over a substrate provided with each contact portion, and by patterning the conductive layer, the second signal wiring 16(a), the second scanning wiring 16(b) electrically separated from the second signal wiring, and the drain wiring 23 are formed.

[0014] In this state, the first scanning wiring 17(a) and the second scanning wiring 16(b) can electrically obtain conductivity by the opening contact portion 19 provided for the both end portions of the second scanning wiring 16(b) (see FIG. 2). Likewise, the first signal wiring 17(b) and the second signal wiring 16(a) can electrically obtain conductivity by the opening contact portion 18 (see FIG. 3). In addition, the drain wiring 23 can electrically obtain continuity by the pixel electrode 20 and the opening

contact portion 24. Here, a signal can be supplied to each pixel by forming the first scanning wiring 17(a) and the second signal wiring 16(a) as a sequential wiring in each pixel.

[0015] As described above, in an active matrix type liquid crystal display device in this embodiment, when a first scanning wiring is formed, a first signal wiring which is to be part of a signal wiring is formed, and when a second signal wiring is formed, part of a second scanning wiring is formed, and each of the first wirings and the second wirings are attempted to electrically contact to each other by providing an opening in part of a layer provided between the both wirings. According to the structure, it is possible that two-layer of the scanning wirings and the signal wirings have both redundant structures; therefore, disconnection defects of each wiring can be dramatically reduced. Additionally, since each wiring has a two-layer structure, it is also possible to reduce the resistance of each wiring.

[0016]

[Effect of the Invention] As described above, according to the present invention, each of a scanning wiring and a signal wiring can have a redundant structure by being patterned once. Thus, the number of patterning is reduced and a redundant structure can be obtained. Accordingly, at the same time of reducing the number of processes, a manufacturing yield can be significantly improved, since even when disconnection occurs in one wiring, the other wiring can cover the disconnection. In addition, the resistance of each wiring can be reduced since each wiring has a two-layer structure. Consequently, according to the resistance reduction, there is also an advantageous effect regarding a delay problem of each signal.

[Brief Description of the Drawings]

[FIG. 1] A plane view of a substantial part of a liquid crystal display device according to an embodiment of the present invention.

[FIG. 2] A cross-sectional view of a substantial part of the device.

[FIG. 3] A cross-sectional view of a substantial part of the device.

[FIG. 4] An equivalent circuit diagram of a general active matrix type liquid crystal panel.

[FIG. 5] An enlarged view of a substantial part of a conventional liquid crystal display device.

[FIG. 6] A cross-sectional view of a substantial part of the device.

[Explanation of Reference]

16(a): second signal wiring

16(b): second scanning wiring

17 (a): first scanning wiring

17 (b): first signal wiring

18, 19 and 24: opening contact portions

[FIG. 1]

16(a): second signal wiring

16(b): second scanning wiring

17(a): first scanning wiring

17(b): first signal wiring

18, 19 and 24: opening contact portions

20: pixel electrode

21: first amorphous silicon layer

22: second insulating layer

23: drain wiring

25: second amorphous silicon layer

[FIG. 4]

1: scanning wiring group

2: signal wiring group

3: field-effect type transistor

4: liquid crystal cell

5: counter electrode

[FIG. 5]

6: pixel electrode

7: scanning electrode (conductive layer)

8: signal electrode

9: drain wiring

10: opening contact portion

11 and 12: first and second amorphous silicon layers

13: second insulating layer

[FIG. 6]

7(a) and 7(b): conductive layers (scanning electrodes)

14: insulating substrate

15: first insulating layer